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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/016,896	12/13/2001	Yu-Chi Sun	B-4418 619378-8	9624

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EXAMINER

NGUYEN, THANH T

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 10/23/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/016,896

Applicant(s)

SUN ET AL.

Examiner

Thanh T. Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 23 September 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 December 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

## **DETAILED ACTION**

### ***Election/Restriction***

In view of the response filed on September 30, 2002, the restriction required set forth in last office action is withdrawn.

### ***Oath/Declaration***

The oath/declaration filed on 12/13/01 is acceptable.

### ***Drawings***

The drawings filed on 12/13/01 are acceptable.

### ***Priority***

Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

### ***Claim Objections***

Claims 4, 5, 8, 9, 12, and 13 are objected to because of the following informalities:

The spacing between words in claims 4, 5, 8, 9, 12, and 13 are more than one space. It is suggested to rewrite the claim with single space between each word. Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

Claims 16-22 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The specification does not disclose the chemical formula of "etch gas containing  $C_nF_{2n-2}$ , wherein  $n = 4$  or  $5$ " as recited in claim 16.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(e) the invention was described in–

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

Claims 1-4, 6-7, 9-12, 14, 16-19 and 21-22 are rejected under 35 U.S.C. 102((a) and/or (e)) as being anticipated by Kim et al. (U.S. Patent No. 6,316,349).

Referring to figures 5-9, Kim et al. teaches a method of forming a self-aligned contact hole suitable for a semiconductor substrate having a pair of gate electrodes comprising the steps of:

Forming a nitride etching stop layer (57, called "etch barrier" in Kim et al., see figure 5, col. 8, lines 18-21) over the gate electrode (53, see figure 5, col. 8, line 14) and the semiconductor substrate (51, see figure 5, col. 8, line 47),

Forming an oxide insulating layer (59, see figure 6, col. 8, lines 38-43) on the nitride etching stop layer (57, see figure 7, col. 8, lines 49-52), and

Plasma-etching the oxide-insulating layer (59, called "dry etching" and is a plasma in Kim et al., see col. 15, line 34) by etching gas containing  $C_4F_6$  and  $CHF_3$  or  $C_5F_8$  and  $CHF_3$  when  $n=4$  or  $5$  so as to form a self-aligned contact hole (SAC, see figure 7, col. 8, lines 1-2, and col. 9, lines 15-21) between the pair of gate electrode (53, meeting claims 1, 9, and 16).

Regarding to claims 2, 10, and 17, the oxide-insulating layer is BPSG (see col. 8, lines 40-42).

Regarding to claims 3, 11, and 18, the oxide-insulating layer is silicon oxide formed by a reactive gas containing TEOS (see col. 8, lines 40-42).

Regarding to claims 4, 12, and 19, the nitride etching stop layer is silicon nitride (see col. 8, lines 22-25).

Regarding to claims 6, 14, and 21, the etching gas further comprises an inert gas (see col. 9, lines 20-21).

Regarding to claims 7, 15, and 22, the inert gas is argon gas (see col. 9, lines 20-21).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 5, 13, 15, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim et al. (U.S. Patent No. 6,316,349) as applied to claims 1-4, 6-7, 9-12, 14, 16-19 and 21-22 above, and further in view of Thei et al. (U.S. Patent No. 6,335,249).

Kim et al. teaches a method of forming a self-aligned contact hole by etching the silicon oxide layer using  $C_5F_8/CHF_3/Ar$ , but fail to teach forming an etch stop layer of oxidized silicon-rich nitride layer (57) can be silicon oxy-nitride. Nevertheless, forming an etch stop layer of silicon oxy-nitride is known in semiconductor processing art as evidenced by Thei et al.. Thei et al. teach a method of forming a self-aligned contact hole (2, see figure 1), forming a gate electrode (16, see col. 1, line 60), forming an etch stop/barrier layer such as silicon oxy-nitride (24, SiON, see figure 1, col. 2, lines 18-20) over the gate electrode (16), forming a interlevel dielectric layer (28, BPSG, see col. 2, lines 20-23), plasma etching the layers to form the opening (2, see figure 1, col. 2, lines 24-26).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made would form an etch stop layer of oxynitride in process of Kim et al. and recognized Kim's oxidized silicon-rich nitride layer having Si-O, Si-Si bond and SiN bond can

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be an oxynitride layer (SiON) as taught by Thei et al. *because* forming an etch stop layer such silicon oxy-nitride would increase the etching selectivity of oxide layer to silicon oxy-nitride layer during the formation of a self-aligned contact hole, so that plasma etching would not etch the gate electrode.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim et al. as applied to claims 1-4, 6-7, 9-12, 14, 16-19 and 21-22 above and further in view of Prall et al. (U.S. Patent No. 6,337,244).

Kim et al. teaches a method of forming a self-aligned contact hole by etching the silicon oxide layer using  $C_5F_8/CHF_3/Ar$ , but fail to teach the specific  $C_5F_8/CHF_3$  mixture ratio of the etching gas that is between 0.4-0.75. Nevertheless, using  $C_5F_8/CHF_3$  mixture ratio of etching gas that is between 0.4-0.75 to etch oxide layer as evidenced by Prall et al. Prall et al. teaches forming a self-aligned contact hole using mixture of  $C_5F_8/CHF_3$  gas at ratio of between about 0.2-5 (see Prall's claims 6, 39 and col. 6, lines 27-35 and col. 8, lines 1-14).

Therefore, it would have been obvious to a person of ordinary skill in the art would use a mixtures of  $C_5F_8/CHF_3$  gas with ratio of 0.4-0.75 to etch an self-aligned contact hole in the process of Kim et al. because the higher the etching selectivity of silicon oxide to silicon nitride layer would prevent over etching on the gate electrode.

*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (703) 308-9439, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:30AM to 4:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, can be reached on (703) 308-4940. The fax phone number for this Group is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (See MPEP 203.08).



Thanh Nguyen  
Patent Examiner  
Patent Examining Group 2800

TTN  
October 10 , 2002